FORECAST OF THE CHIGNIK SOCKEYE SALMON RUN IN 1966

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Note: Prior to the 1966 field season, the original unpublished copy of the
1966 Chignik forecast report was misplaced while being prepared for
publication. Due to the shortage of time just prior to the field season
and because a copy of the original forecast was included in the 1965
Chignik annual report which was available April 22, 1966, it was de-
cided to delay the formal 1966 forecast publication until after the 1966
field season. The main purpose in publishing this forecast after the
season is to preserve the continuity of these reports, especially as
they provide a means of annually updating the data on which forecasts
are based.

CORRECTIONS FOR INFORMATIONAL LEAFLET NO. 90

Page 5, Table 2, columns 2,3 & 4; early run (Black Lake)
                   columns 5,6 & 7; late run (Chignik Lake)

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BACKGROUND

Chignik sockeye salmon runs during the past eleven years have ranged in size from 646,000 to 1,285,000 and averaged approximately 893,000 sockeye annually. The Fisheries Research Institute first began forecasting these runs in 1958 and was joined by the Alaska Department of Fish and Game in 1961 in an effort to consolidate the collection and evaluation of existing data. The method of forecast is based primarily on the relationship between .2 fish returning in year N and .3 fish in year N + 1 and the average annual returns of .2 and .3 fish. Information obtained from lake studies which is pertinent to the forecast is also discussed.

FORECAST

Sockeye salmon runs returning to Chignik are composed of fish bound for two major spawning areas in the watershed. On the basis of past time of entry data of the two major spawning stocks, the total return is divided into two segments: (1) the early run (through June 30) which is destined largely for the spawning tributaries of Black Lake and (2) the late run (after June 30) which is bound for the Chignik Lake spawning areas.

The early (i.e. Black Lake) run exhibits a highly significant (r = 0.885, d.f. = 7) linear relationship between returns of .2 fish in year N and .3 fish in year N + 1. The data and the line fitted to this data is shown in Figure 1. The return of .3 fish in 1964 is considered an outlier and was not included in the analysis.
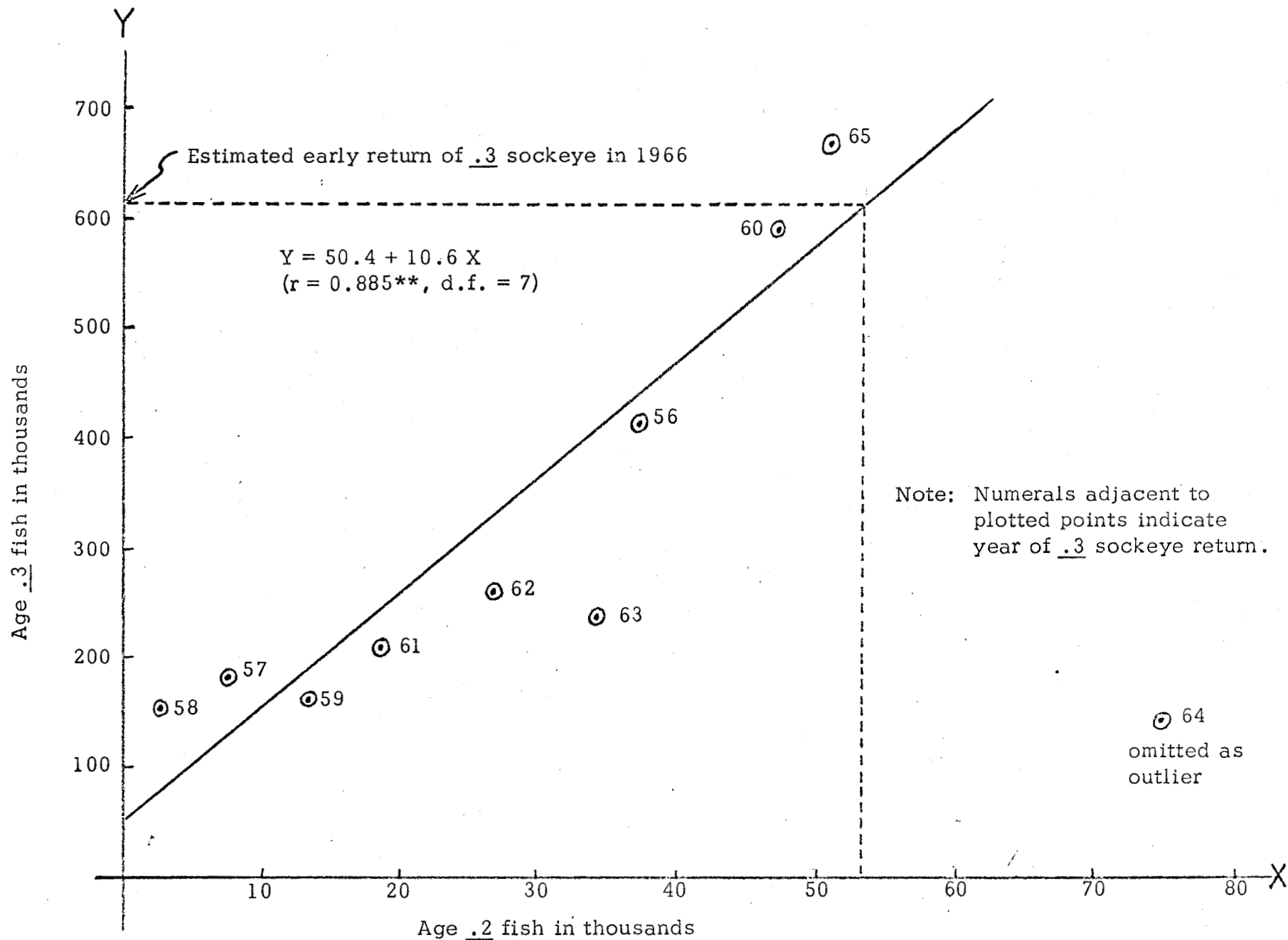
Figure 1. Regression of age .3 sockeye return in year N + 1 on age .2 sockeye return in year N for early run (prior June 30) 1956-1965.

The late (i.e. Chignik Lake) run shows little or no relationship between .2 fish returning in year N and .3 fish returning in year N + 1 (cf. Figure 2). Therefore, the average return of .3 fish has been used in the past as an estimate of the .3 fish to be returning.

For both the early and late runs, the average annual return of .2 fish has been used in the past as an estimate of the .2 fish to be returning.

Table 1 shows the success of past forecasts in terms of relative error between the forecasted return and actual return for the years 1958-65.

Table 1. Chignik Forecasts, 1958 - 1965. (No. of fish in thousands)

Year	Predicted Return	Actual Return	Percent Relative Error
1958	621	646	-3.9
1959	834	827	-0.8
1960	1,900	1,285	+47.9
1961	795	721	+10.3
1962	940	801	+17.4
1963	1,348	906	+48.8
1964	1,340 1/	739	+81.3
1965	1,200	1,053	+14.0

1/ Qualified on basis of contradictory evidence from lake studies.

In 1964, it was noted that the relationship of .2 fish in year N and .3 fish in year N + 1 may be less reliable as a basis for forecast when large returns of .2 fish occur. Since 1964, information on the sockeye during their lake residence has been considered in an attempt to provide a more accurate method of forecasting returns.

Adult Return Analysis

The basic data used for forecasting the 1966 sockeye return to the Chignik system is given in Table 2.
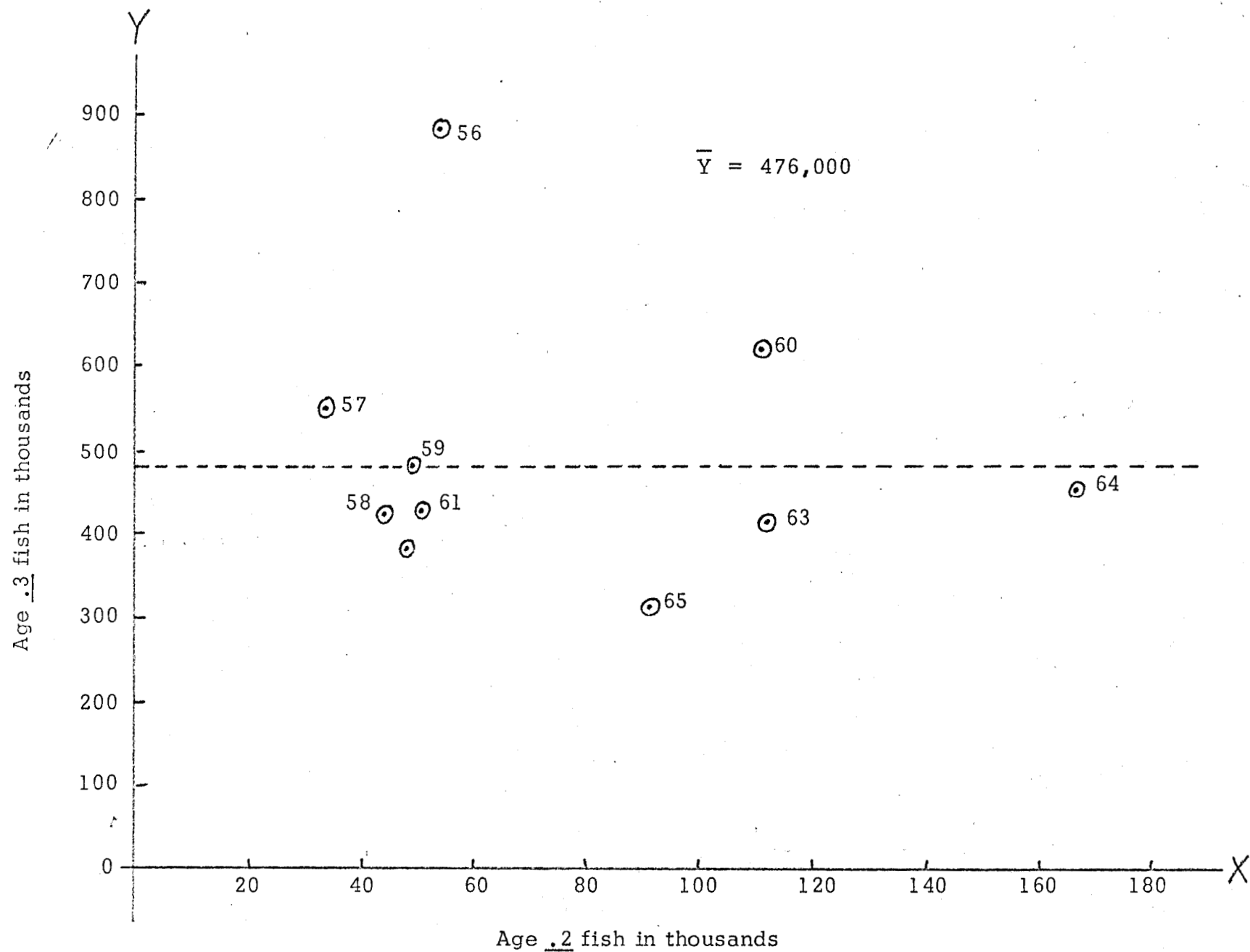
Figure 2. Regression of age .3 sockeye in year N + 1 on age .2 sockeye in year N for late run (after June 30) 1956–1965.

Table 2. Red salmon runs to the Chignik system, 1955-65.
(No. of fish in thousands)

Year	.2	.3	Total	.2	.3	Total	Total Return
1955	37.8	403.2	441.0	54.2	300.3	354.5	795.5
1956	7.5	419.1	426.6	34.4	882.1	916.5	1,343.1
1957	2.6	183.0	185.6	44.0	550.3	594.3	779.9
1958	13.7	151.5	165.2	49.6	429.8	479.4	644.6
1959	40.7	165.6	206.3	112.4	475.0	587.4	793.7
1960	18.5	593.4	611.9	51.6	624.0	675.6	1,287.5
1961	26.7	211.6	238.3	47.1	430.6	477.7	716.0
1962	34.2	263.1	297.3	112.8	377.0	489.8	787.1
1963	75.1 [1]	242.8	317.9	166.0	408.0	574.0	891.9
1964	50.6	146.0 [1]	196.6	91.7	451.2	542.9	739.5
1965	53.6	674.2	727.8	13.7	306.1	319.8	1,047.6
Averages	32.8	314.0	346.8	70.7	475.9	546.5	893.3

[1] Omitted from regression analysis.

The early run in 1966 will be composed of the progeny of the 1960 and 1961 brood year. The return of .2 fish during June, 1965 was the second largest on record and indicates a large return of .3 fish in 1966. Age composition of the .2 fish in the early 1966 run also indicates a larger than average early return of .3 fish in 1966. A large majority of the early run .2 fish in 1965 were age 2.2 progeny of the 1960 year class which produced a record early return of 760,000 fish in June, 1965 (Figure 3). This large return of age 2.2 fish (1960 brood year) coupled with the large return of age 1.2 fish (1961 brood year) indicates a larger than average return of 2.3 and 1.3 fish in 1966.

Regression analysis of age .3 fish in year N + 1 on age .2 fish in year N yields the following equation:

$$Y = 50.4 + 10.6 X \qquad (1)$$

A highly significant correlation (r = 0.885**, d.f. = 7) is indicated between the two variables.

On the basis of a .2 sockeye early return of 53,600 sockeye in 1965, Eq. (1) yields a predicted early return of 618,600 .3 sockeye in 1966.

The 11-year average early return of 32,800 .2 sockeye is used as an estimate of the early return of .2 sockeye in 1966. This yields a total predicted early return of 651,400 sockeye in 1966.

The total late run (after June 30) has been relatively constant during the period 1955-65 (refer to Figure 4). However, the late run in 1965 was only slightly greater than half the eleven-year average. The small magnitude combined with the age composition of the 1965 late run indicates another poor late run in 1966. Although there is no apparent relationship between the return of .2 fish in year N and .3 fish in year N + 1 for the late run (Figure 2), the total late return of .2 fish in 1965 was the lowest on record (14,000 compared to an average of 71,000 and a high of 166,000 in 1963). This suggests poor survival of the 1960 year class reared in Chignik Lake.

Ecological studies of the nursery lakes conducted at Chignik by the Fisheries Research Institute since 1960 give evidence of a poor late return in 1966. Growth of the 1960 year class in Chignik Lake was suppressed by a large influx of Black Lake fry in 1961 which will return as age 2.3 fish in the 1966 early run. Furthermore, an apparent mortality of young sockeye salmon in Chignik Lake was witnessed by Institute personnel in the spring of 1962. The magnitude of the mortality was not completely assessed but it is noteworthy that very few age .2 fish of the 1960 year class returned in the late run of 1965.

The forecast for the late run in 1966 is difficult to pinpoint due to the lack of quantitative method of prediction for this segment. However, it should
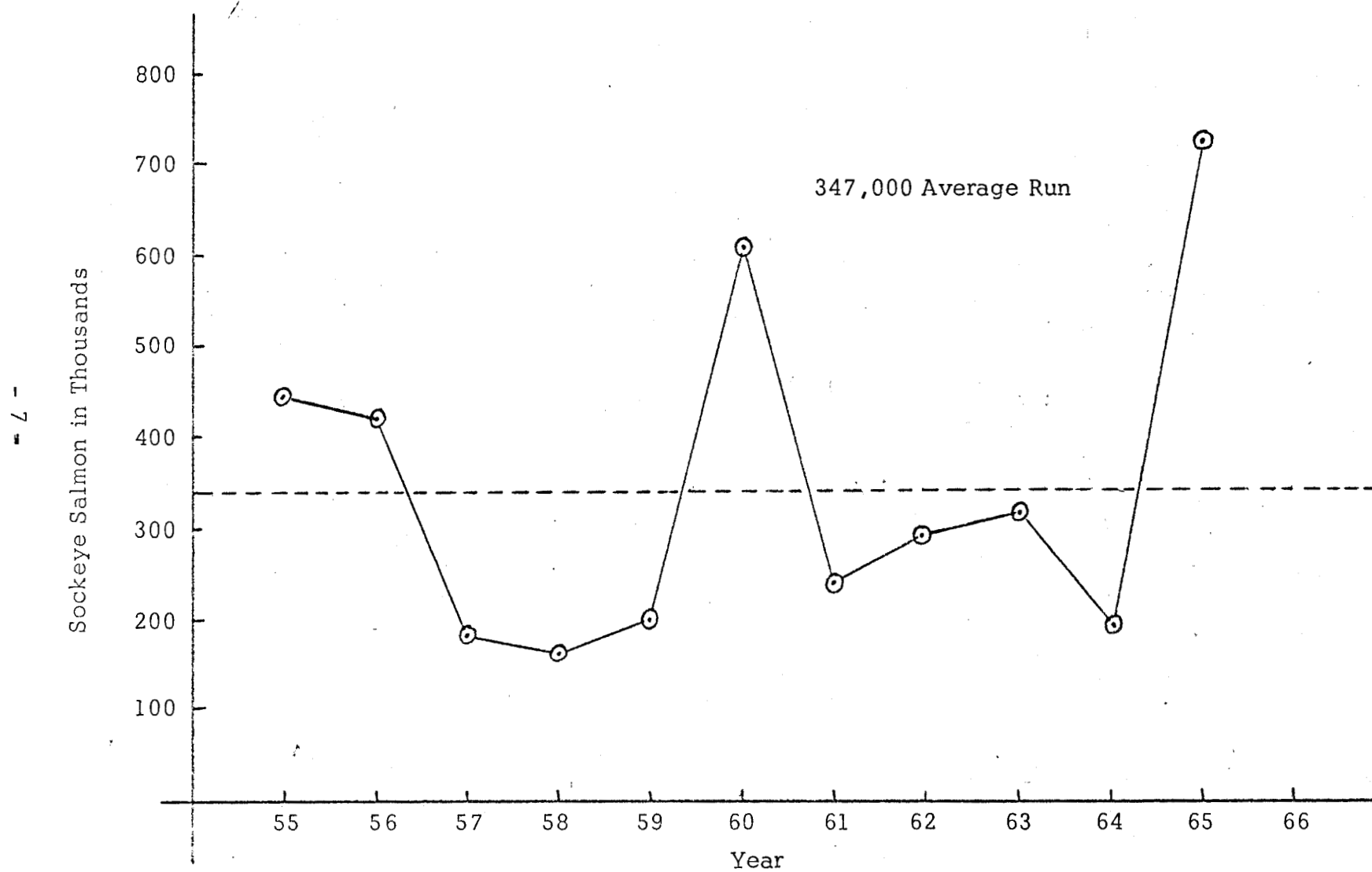
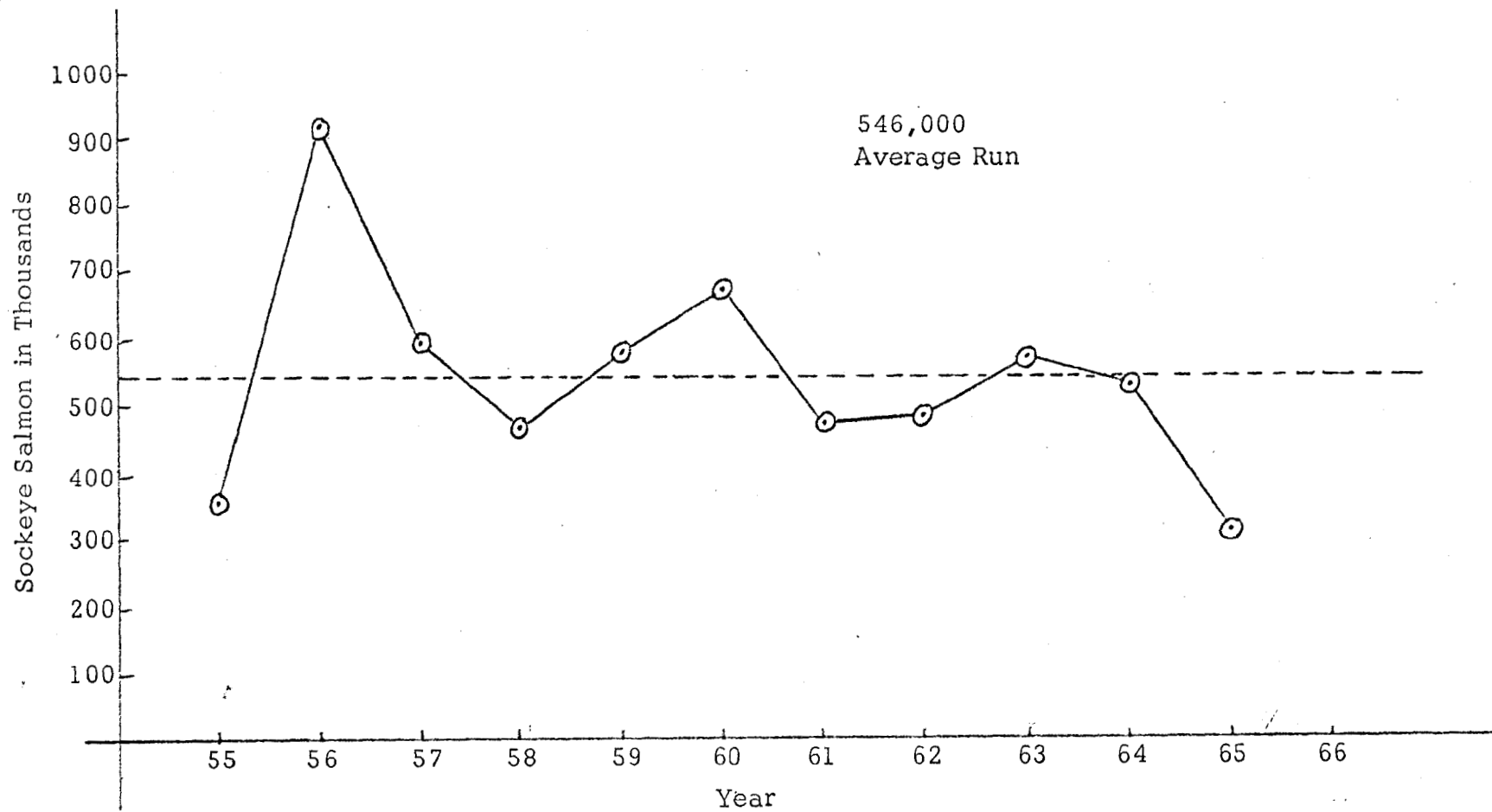Figure 3. Total Chignik early sockeye run by year, 1955-65.

Figure 4. Total Chignik late sockeye run by year, 1955-65.

be a poor run similar to the one in 1965. A conservative estimate for 1966 would be in the neighborhood of 400,000 fish, somewhere between the average late run of 546,000 and the lowest observed late run of 319,000.

SUMMARY

The total adult sockeye salmon return to Chignik in 1966 should be better than the past eleven year average of 893,000 fish. However, there is a considerable difference in the expected return of the two stocks making up the total run. The early run (through June 30) should be much larger than average while the late run (July 1 on) is expected to be smaller than usual.

Even though our studies indicate a good return in 1966 there are two possible sources of error in the forecast. First, we have no measure of marine survival, hence the expected large early return of age .3 fish may not materialize in 1966. A second source of error is the incidental harvest of sockeye salmon bound for Chignik at other places along the Alaska Peninsula. Analysis of tagging studies and catch records strongly suggest that the Stepovak Bay and Cape Kumlik fisheries take a portion of the Chignik run, especially the latter fishery.

Summarizing, we expect the early run (through June 30) to be in the neighborhood of 650,000 fish and the late run (July 1 on) to be approximately 400,000 fish for a total return of around 1,050,000 sockeye salmon.